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ORIGINAL ARTICLE

ASSOCIATION OF PECTORALIS MINOR MUSCLE LENGTH AND SHOULDER RANGE OF MOTION AMONG INDIVIDUALS WITH AND WITH OUT SHOULDER PAIN

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ABSTRACT

Background and Aim: To evaluate the association of pectoralis minor muscle length and the shoulder range of motion with and without shoulder pain.

Methodology: A sample of 214 participants with and without shoulder pain were enrolled in an analytical cross sectional study at Institute of physical medicine and rehabilitation, Dow University of health sciences, Karachi. Questionnaire was provided to all participants after taking consent. Individuals were categorized into two equal groups i.e. one with and the other without pain). Shoulder active ranges were measured with universal goniometer and pectoralis minor length with measuring tape. Statistical Package of Social Sciences version 21 was used for data analysis. The descriptive variables were assessed for frequencies and percentages. Continuous variables were shown with mean and standard deviations and were correlated with bivariate correlation test. Considered significant was 0.05 p value.

Results: Females were 176(82.2%) and males were 38 (17.8%). Mean ± SD of age, weight, height, and BMI were 26.82 ±7.50, 58.45 ±12.11, 160.59 ± 12.43, and 22.18 ±3.78 respectively. The pain intensity negatively correlated with shoulder range of motions (rs = -0.307 to -0.775, p< 0.05) except medial rotation. Significant difference (p< 0.05) is found for length of pectoralis minor and range of motion between groups. There was also weak positive correlation between pectoralis minor index and shoulder lateral rotation (rs =0.215; p = 0.003).

Conclusion: The shoulder pain affects shoulder joint range of motion and pectoralis minor length. Decreased pectoralis minor muscle length accompanies limited shoulder range of motion except, medial rotation.

The Ziauddin University is on the list of I4OA, I4OC, and JISC.

Conflict of Interest: *The author (s) have no conflict of interest regarding any of the activity perform by PJR.*

Keywords: *Physical examination, glenohumeral joint, posture, movement, asymptomatic shoulder, symptomatic shoulder.*

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Introduction

The shoulder pain is one of the commonest complain among general population. Moreover, along with postural issues, it is the most common work related musculoskeletal disorder[1].This joint is less stable and more mobile, anatomically. These characteristics make shoulder to be injured and painful, easily[2]. Structurally, shoulder is composed of various connective tissues. Shoulder gives connects axial skeleton and the upper extremity and participates for upper extremity movements, primarily. This function of shoulder requires all surrounding structures to be intact[3]. The lifetime prevalence of pain in shoulder is about 67%[2]. The literature shows that higher prevalence among females (24.9%) than males (15.4%)[4]. The occupation of school teachers has 66.7% in China[5].The point prevalence of shoulder pain in a systematic review is found to be 10.5% to 28.7%[6]. Different studies reveals that in the developed societies, the prevalence of shoulder pain is directly proportional to age[7,8]. And is most significantly increase in between 50-56 years[4]. The upper body bad postures, such as rounded shoulder, forward headed, poke chin and slouched posture have been suggested as the possible predisposing factors when there is no specific. These are suggested in pathogenesis of many clinical conditions which involve the shoulder[5,9]. Shortened pectoralis minor muscle (PMM) and abnormal posture are supposed to participate to stimulate pain and to decrease normal daily activities of upper quadrant of the body[9]. Furthermore, any alteration in the structures that forms the shoulder joint can results in scapular dyskinesis which is defined as the abnormality of the scapula posture or movements[10].

The physical examination of surrounding structures is an important element to evaluate any shoulder problem[3].The physical examination of shoulder comprises objective findings of range of motion (ROM) and length of soft tissues to identify impairments causing pain. The length of PMM can be one of the causes to affect the normal scapular function. So, this fact also suggests, its association with the shoulder pain[11]. Kinematics alteration and the asymmetrical changes in the shoulder joint have been widely reported among both the symptomatic and asymptomatic individuals. There are various findings on the relationship between the PMM length (PMML) and the shoulder kinematics[12] but as far as the authors knowledge there are still some specific limitations left with regards this issue. So, this study purpose is to assess the significant statistical association between PMML and shoulder ROM among the participants with and without shoulder pain.

Methodology

The study design was analytical cross sectional. Participants were recruited with convenient sampling technique at Institutes of physical and medical rehabilitation, Dow University of health sciences, Karachi. However, duration of study was from August to October, 2019. The institutional review was taken from the same institute. Sample of 214 participants with and without shoulder pain were included in the study. This sample size was extracted from degree of external rotation in pain (101.94±13.45) and without pain (107.06±13.26) of previous literature[13] along with confidence interval of 95%, margin of error of 5% and power 80% through open epi. Inclusion criteria were age range between 20 – 50 years with ability to do no less than 90 degree of arm elevation. Individual having at least one week onset of symptoms were included for group of individuals with pain. Exclusion criteria comprised participants with BMI >28 kg/m^2 to avoid error during palpitations, pregnancy, ligamentous hyper laxity of gleno-humeral with presence of sulcus sign, shoulder apprehension test and shoulder anterior drawer test. The individuals having history of adhesive capsulitis, any systemic illnesses, any shoulder trauma and surgery, any neurological condition (cervical radiculopathy), individuals taking any immunosuppressive medicine were also excluded[11]. A screening Performa was used to screen exclusion criteria. The investigators screened and provided self-designed questionnaire to all study participants after taking consent. Each of the participants willingly participated and was allowed to refuse further participation at any time. The questionnaire comprised demographics (gender, level of education and marital status), question regarding presence of shoulder pain within last 3 months. Participants were asked to rate their intensity pain after responding 'yes' to presence of pain. The PMM was measured with measuring tape and pectoralis minor index (PMI) test was used to assess the PMT[11]. However, the universal goniometer (UG) with long-arm was used to assess active ROM (AROM) of shoulder joint[3]. PMML was measured for symptomatic side in the group with pain. However, side for this measurement was selected randomly in the group without pain[11]. All the data was collected within

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constraints. Privacy of participants was considered. Data was entered and analysed through SPSS version 21. The descriptive variables like gender were reported through frequencies and percentages. The continuous data like age, height, weight, BMI, Shoulder ROMs, PMML and PMI was calculated for mean and standard deviations. Shapiro-wilk test was used to identify normality. The value for shapiro-wilk test for asymptomatic individuals showed 0.001 and for symptomatic individuals' 0.000 i.e. less than the value (0.01) so that the data was non symmetrical, so spearman's test was used for correlation of continuous outcome data. The Mann Witney U test was also employed to compare variables of two groups symptomatic and asymptomatic. The considered significant p-value was less than 0.05.

Pectoralis minor muscle length measurement

Position of participant was sitting. Assessor marked after palpation of inferior part of the medial border of the coracoid process and inferior edge of the fourth rib at the sternum. Centimeter measuring tape was used to measure distance between these two points[14,15]. Mean value of three times measurements was recorded[15]. The mean PMML for each individual was divided by height of the same individual and then multiplied by 100 in order to calculate the PMI. The suggested range of PMI refers short PMM when it is 7.65 or lower[9,15].

Shoulder joint range of motion measurement

The individual was in upright sitting position on a high back chair. The fulcrum of UG was placed at inferior and lateral to the acromion process, the stable arm was placed parallel to the trunk and the moving arm parallel to the long axis of the humerus[16,11]. Then investigator assessed abduction in the same position, with active elevation of arm in coronal plane and the fulcrum of goniometer was placed at the midpoint of the posterior aspect of the glenohumeral joint with placing the stable and moving arm as same as for active flexion ROM[16]. Then the two movements external and internal rotation were assessed by the investigator in supine position with both hips and knees flexed in 45 degrees. Upper limb was in supported position with 90 degrees' abduction with 90 degrees' elbow flexion and neutral wrist. After this, the individual was asked to rotate their arm again in external rotation, and internal rotation maintaining the 90 degree abducted position to their end range without feeling of discomfort. After end range, stable arm and movable arm of goniometer was placed parallel to the floor and forearm respectively. [16,11] All ranges in degrees were recorded.

Ethical Concerns

All the data was collected under ethical constraints. After institutional approval from same institute the informed consent was taken from all participants before commencement of study. The study followed the declaration of Helsinki.

Results

Out of 214 participants, majority were females (table 1). The demographical data is shown in table 1. The mean age, height, weight and BMI were 26.82 ±7.50, 160.59 ± 12.43, 58.45 ±12.11and 22.18 ±3.78, respectively. The mean NPRS of symptomatic individuals were 3.4±1.5. About 73(68.2%) of symptomatic individuals had right side shoulder pain and 34(31.8%) had left side shoulder pain. However, table 2 shows the calculated mean and SD of shoulder range of motions, PMI and PML.

Variables	Mean (SD) n=214
Flexion (°)	167(17.1)
Abduction (°)	160.24(22.17)
External rotation(°)	76.03(17.49)
Internal rotation(°)	76.75(13.68)
Pectoralis minor index (score)	9.42(1.93)
Pectoralis minor muscle length (cm)	15.07(2.87)

Table 1; Demographical data of all participants

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Variables	Frequency (%) n=214
Gender	
Male	38 (17.8)
Female	176(82.2)
Level of education	
Illiterate	11(5.1)
Primary	5(2.3)
Matric	13(6.1)
Intermediated	66(30.8)
Graduate	85(39)
Postgraduate	34(15.9)
Marital status	
Married	90(42.1)
Unmarried	122(57)
Divorced	2(0.9)

Table 2; Mean and SD of shoulder range of motion and pectoralis minor index and length

The table 3 manifests the significant difference (p-value < 0.05) of all variables between groups with and without shoulder pain. Shows the significant difference (p< 0.05) of all variables between groups with and without shoulder pain.

Variables	Asymptomatic Mean(SD) n=107	Symptomatic Mean (SD) n=107	P-value
Age (years)	23.65 (4.02)	30 (8.74)	0.000*
Height(cm)	160.3 (10.74)	160.8 (13.96)	0.687
Weight(kg)	54.17 (10.62)	62 (12.9)	0.000*
Flexion(°)	175.4 (6.75)	160.3 (2.08)	0.000*
Abduction(°)	169.4 (12.39)	151 (25.72)	0.000*
External rotation(°)	84 (6.10)	67.50 (20.7)	0.000*
Internal rotation(°)	83.1 (7.22)	70.3 (15.5)	0.000*
Pectoralis minor index (score)	16.89 (2.06)	13.24 (2.35)	0.000*
Pectoralis minor muscle length (cm)	10.59 (1.46)	8.25 (1.6)	0.000*

* (p< 0.05 is considered significant)

Table 3; Difference of variables between groups

Spearman correlation	Numerical pain rating scale	
	Correlation coefficient	P-value
Flexion(°)	-0.307	0.001*
Abduction(°)	-0.367	0.000*
Lateral rotation(°)	-0.775	0.000*
Medial rotation(°)	0.075	0.441
Pectoralis minor index	-0.163	0.093

* (p< 0.05 is considered significant)

Table 4; Relationship of Numerical pain rating scale with different variables among individuals with shoulder pain

The spearman correlation showed significant weak positive correlation between PMI and degree of shoulder active lateral rotation (rs =0.215; p = 0.003) only among all participants. Whereas the spearman correlation showed moderate negative correlation of NPRS with flexion, abduction and lateral rotation of shoulder among symptomatic group in table 4.

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Outcome Measures

The outcome measures used in this study were centimeter measuring tape to measure the length of pectoralis minor muscle and the universal goniometer used to assess the active ROM of the shoulder joint.

Discussion

This study evaluated the relationship of PMML and the ROM of the shoulder among individuals with and without shoulder pain. Findings suggest weak positively correlation of PMM and shoulder lateral rotation among all individuals. The symptomatic group showed decreased PMML and shoulder ROM with significant difference between both groups. However, intensity of pain moderate negatively correlated with shoulder flexion, abduction and lateral rotation.

The measurement of shoulder ROM and muscle length has been remain a critical feature of a clinician's evaluation.[17],[18] The goniometry for shoulder AROM and measuring tape test to measure the length of PMML has been shown good intra- and interrater reliability along with between-day reliability for PMML among individuals with and without shoulder pain through the previous studies[14,17,18]. The current study included the same clinical test and outcome tools for better outcome results among individuals with and without shoulder pain. The length of PMM is assumed to be one of the potential biomechanical factor that associates with altered shoulder movement during daily activities[13,18]. A cross sectional study was held to evaluate association between PMM resting length and external rotation ROM of shoulder joint in participants with and without shoulder pain. The study was conducted among 50 adult individuals. Findings suggested PMML is not correlated with external rotation ROM of shoulder joint in individuals with and without shoulder pain[11]. The current study showed contrary results suggesting positive association of PMM resting length and external rotation ROM of shoulder joint. However, sample size of current study included 214 individuals with and without shoulder pain of same age group as previous study[11], comprising for females.

The direct and indirect relationship of PMML with shoulder pain is questionable and different mechanism are needed to be identified[18,19,20]. Previous cross sectional study was held amidst 54 individuals with shoulder pain and 54 without shoulder pain. The results suggest PM resting length is associated with shoulder pain[21]. Current study follows that study with larger sample size as it found significant difference in PM resting length between groups of shoulder pain and without shoulder pain suggesting its association with shoulder pain[22,23]. Another cross sectional study was done to evaluate relationship between the scapular upward rotations and the pectoralis minor and levator scapulae muscle lengths among 54 participants with the chronic shoulder pain. It was found that there is small correlation between the shoulder pain and the pectoralis minor and the levator scapulae lengths. The strong association was also found between the pectoralis minor muscle and the levator scapulae lengths[24] However, in comparison to this study the current study used a large sample size and a significant difference is found in the pectoralis minor muscle resting length between the two groups of with and without shoulder pain which suggests the pectoralis minor muscle length association with the shoulder pain.

Shoulder pain and ROM has also point of discussion[22]. A cross sectional study was done on 35 individuals in order to evaluate the association between the pectoralis minor muscle tightness and cervical ROM and strength in car drivers. The findings of that study suggests that the cervical lateral flexion also showed positive correlation with the contralateral pectoralis minor muscle tightness[25]. But in this study we were only concerned with the association of pectoralis minor muscle tightness and the shoulder range of motion and found moderate negatively correlated with shoulder flexion, abduction and lateral rotation. Current study provides results related to shoulder ROM. Another cross sectional study of 64 participants in Saudi Arabia found good negative correlation of the shoulder flexion, abduction, and rotation ROM with NPRS.[22] however, the current study showed moderate negative correlation same outcome tools but there was no larger symptomatic sample.

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The study limitations include the choice of convenient sampling technique but there was larger sample size with reliable and standard outcome tools. There could be error in manual examination but three times reading average was taken to avoid those errors.

Conclusion

The study results suggested that shoulder joint ROM and PMML is affected with shoulder pain. The change in length of PMM affects shoulder range of motions except, medial rotation. Furthermore, increase in intensity of pain accompanies decrease in shoulder ROMs.

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